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Morphology and Anatomy of a New Iberian Species: *Deroceras geresiensis* (Gastropoda: Pulmonata: Agriolimacidae)

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Abstract. Periodic, systematic sampling of the western Iberian Peninsula, comparison of specimens collected with topotypes of *Deroceras lombricoides* (Morelet, 1845), and analysis of the descriptions of *D. lombricoides* given by Morelet and Simroth have shown that Simroth's description of this species is confused with that of a quite distinct agriolimacid characterized by two glandular spheres on the distal penis, each of which houses a tongue-like stimulator. The morphology and anatomy of this second species, which we consider as new to science, are described and compared with those of other species living in the same region. We also report what appears to be its present distribution.

INTRODUCTION

In describing the copulation of *Deroceras lombricoides* (Morelet, 1845), SIMROTH (1891) stated that the pair took up positions next to each other forming a circle, and that they each produced, from the genital orifice, a stimulator consisting of a thick flat triangular lip with which they touched each other's back (SIMROTH, 1891:pl. 3, fig. XI). A few lines later, however, he described different mating behavior in a pair observed in Oporto: these slugs alternately moved round in a circle and stayed still, the stimulator remaining in contact with the mate all the time. Drawings of this latter copulation were provided (SIMROTH, 1891:pl. 3, figs. XIII–XV), but not of the mating slug's genitalia, though in the text it is mentioned that when the specimens were placed in alcohol, one of them evaginated a kind of "spoon," round outside and concave inside, whose tip exhibited pale epithelial formations differing from the rest of the evaginated structure. Simroth regarded this structure as a stimulator related to two whitish vesicles observed during copulation.

Examination of topotypes of *Deroceras lombricoides* has led us to the conclusion that Simroth's description and drawings of the copulation of this species (SIMROTH, 1891: pl. 3, figs. XI–XVI) refer to two quite distinct species: figs. XI, XV, XVIa, and XVIb depict *D. lombricoides s.s.*, but figs. XII–XIV show a different species that, as Simroth himself noted (SIMROTH, 1891:285–286), was characterized by two glandular spheres on the penis, each containing a stimulator. Sampling of several sites in Portugal has yielded 97 specimens of this latter species. After examination of its anatomy and copulation (which was photographed), we conclude that it is a new species, and we here name it.

Deroceras ***geresiensis***
Rodriguez, Castillejo & Outeiro, sp. nov.

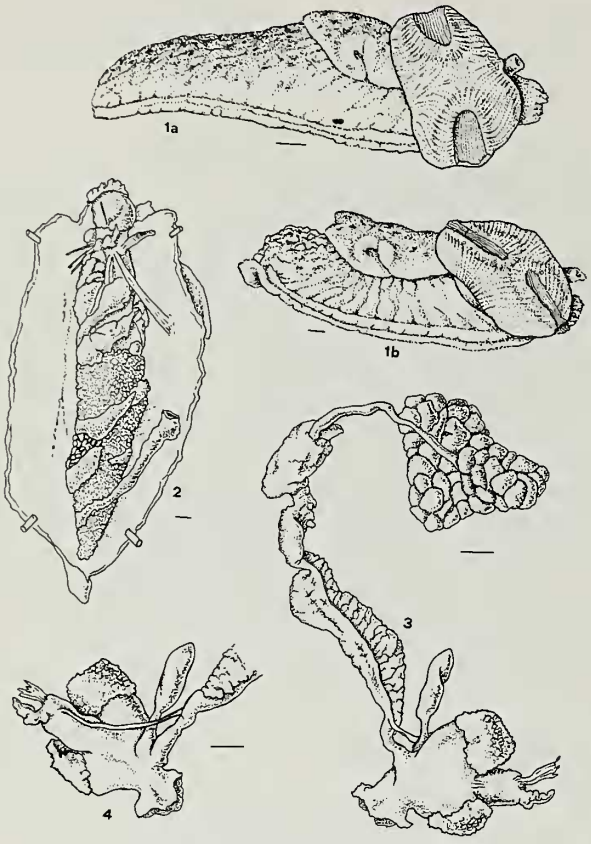
(Figures 1–42)

Diagnosis: External anatomy, limacella, pallial complex, and internal topography all common to other species of the same genus. Differences: penis divided in a voluminous anterior region with two spheres of glandular appearance, and a cylindrical posterior region with a short, wide caecum on which the vas deferens end; two stimulators, tongue-shaped, located in the roof of the penial sphere; penial gland (=flagelliform appendices) terminal, subdivided into two or three festooned diverticula of variable length.

Description: Length *in vivo* up to 30 mm, length in 70% alcohol up to 22 mm (Figures 1a, b). Back dark chestnut in color, lighter at sides and neck. Epidermis irregularly speckled with darker spots. Sole whitish, divided into three regions. Body mucus colorless.

Organs *in situ*: Organs exhibiting topography characteristic of the genus (Figure 2). Intestine with three circumvolutions, rectum with no caecum. Ovotestis to the left of the last one-third of the visceral sac, approaching the rectum ventrally. Conjunctive tissue enveloping the visceral sac colorless.

Pallial complex (Figure 5): As in other species of the genus. In the paratype depicted here, kidney lobe projecting over the rectum smaller than in other specimens.



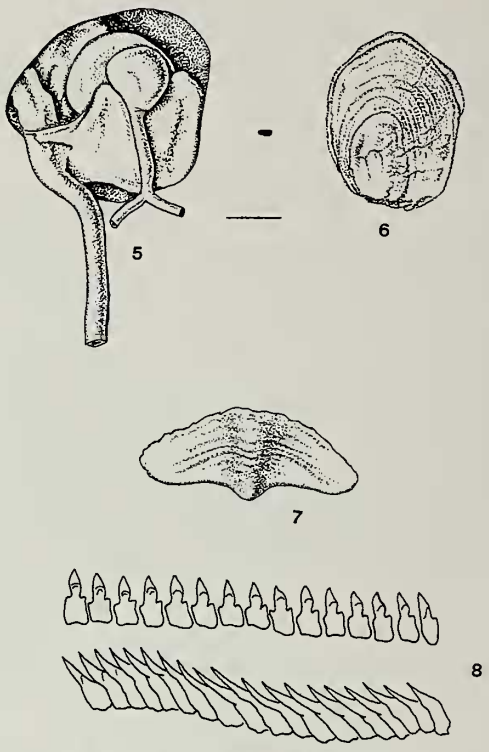
Explanation of Figures 1 to 4

Deroceras ***geresiensis*** Rodriguez, Castillejo & Outeiro, sp. nov.

Figures 1, 2. Specimens with the distal penis evaginated. 1a. Paratype from Taipas in the hills around Braga. 1b. Paratype from Pontefeia, Serra do Gerês. 2. Holotype, organs *in situ*.

Figures 3, 4. Holotype, dorsal and ventral views of the genitalia.

Scale, 1 mm.



Explanation of Figures 5 to 8

Deroceras ***geresiensis***. Paratype from Pontefeia.

Figure 5. Pallial complex.

Figure 6. Limacella.

Figure 7. Mandible.

Figure 8. A row of teeth.

Scale, 1 mm.

Limacella (Figure 6): Roundish, very fragile, with a subterminal nucleus.

Mandible (Figure 7): Oxygnate.

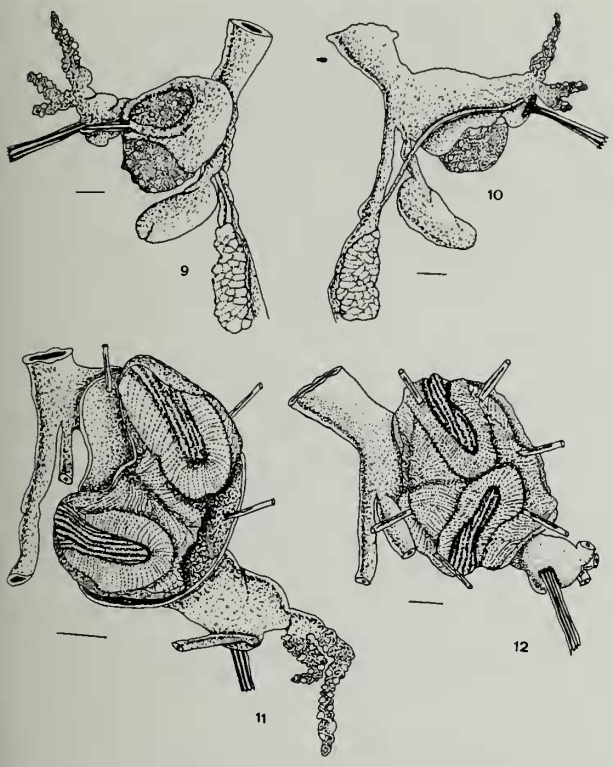
Radula (Figure 8): Central teeth tricuspid, lateral ones bicuspid, and marginal ones monocuspid. Formula: (C/3 + 12–13/2 + 21/1) × 94.

Genitalia (Figures 3, 4, 9–12): Ovotestis formed by black acini in sexually mature individuals. Topography of the hermaphrodite duct, albumin gland, and spermoviduct characteristic of the genus.

Proximal penis cylindrical, with a slight subterminal swelling. Penial gland terminal, divided in two or three branches of variable length with festooned margins. Distal penis thick, spheroid, with two globose masses of glandular appearance. Vas deferens short, not variable in caliber, ending on the penial body below the penial gland near the insertion of the penial retractor muscle. The latter long, inserted at one end near the pallial complex; at the other end it bifurcates, one branch being inserted on the proximal portion of the penis and the other near the base of the spheroid masses.

Bursa copulatrix ovoid, with a short duct. Free oviduct, as long or longer than the bursa copulatrix duct. Internal wall of the penis lined with fine longitudinal grooves continuing into the walls of the spheroid masses. The roof of each of these masses exhibiting a tongue-shaped, more coarsely grooved stimulator at the tip of which the external glandular mass. Only the distal penis protracted during copulation, on which occasion the stimulators and the orifices communicating the glandular masses with the inside of the penis clearly visible. The stimulators well differentiated in sexually mature individuals only; immatures exhibit triangular areas in which the epithelial grooving differs of the rest of the penis.

Etymology: This species has been named *Deroceras geresiensis* because it was collected in the Serra do Gerês, Portugal.



Explanation of Figures 9 to 12

Deroceras ***geresiensis***. Genitalia of paratypes from Pontefeia.

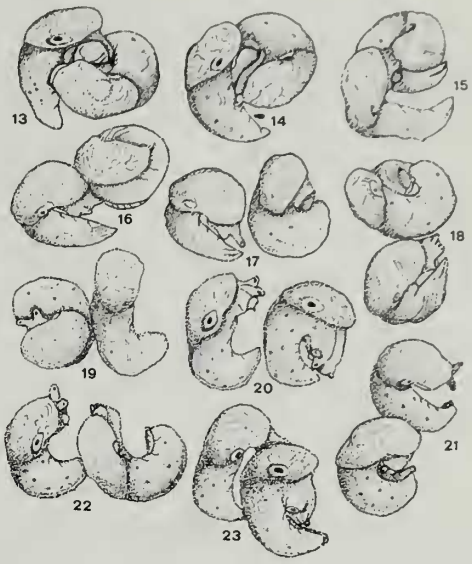
Figures 9, 10. Dorsal and ventral views.

Figures 11, 12. Interior of the distal penis showing the two stimulators.

Scale, 1 mm.

Material examined (Figure 43): *Holotype:* Curral de Leonte, Serra do Gerês (Portugal, U.T.M. 29TNG72), *leg.* J. Castillejo, 1 Nov. 84. Deposited in the Natural History Museum, Madrid, Spain (NHMM).

Paratypes: 18 specimens collected in the same site and in the same day as the holotype: 4 of NHMM, 5 in the Luis Iglesias Museum, Santiago (LIMS), 2 in the collection of the Zoology Department, University of Santiago de Compostela (ZDUS); 7 in the Natural History Museum, Wroclaw, Poland (NHMW). Pontefeia, Serra do Gerês (Portugal, U.T.M. 29TNG72), 9 Feb. 84, *leg.* J. Castillejo (4 specimens ZDUS, 2 spec. in the collection of Dr. Giusti, Siena, Italy (CGMI). 1 Nov. 84, *leg.* T. Rodríguez (4 spec. ZDUS). Feitos, Barcelos (Portugal, U.T.M. 29TNG20), 31 Oct. 84, *leg.* A. Outeiro (4 spec. ZDUS). Taipas, Mountain of Braga (Portugal, U.T.M. 29TNF59), 14 Dec. 85, *leg.* J. Castillejo (6 spec. ZDUS, 1 spec. CGMI). Pintos, Pontevedra (Spain, U.T.M. 29TNG39), 1 Mar. 84, *leg.* J. Castillejo (38 spec. ZDUS, 4 spec. CGMI); 28 Sept. 86, *leg.* T. Rodríguez (7 spec. ZDUS). Arbo, Pontevedra (Spain, U.T.M. 29TNG56), 1 Mar. 84, *leg.* J. Castillejo (6 spec. ZDUS).



Explanation of Figures 13 to 23

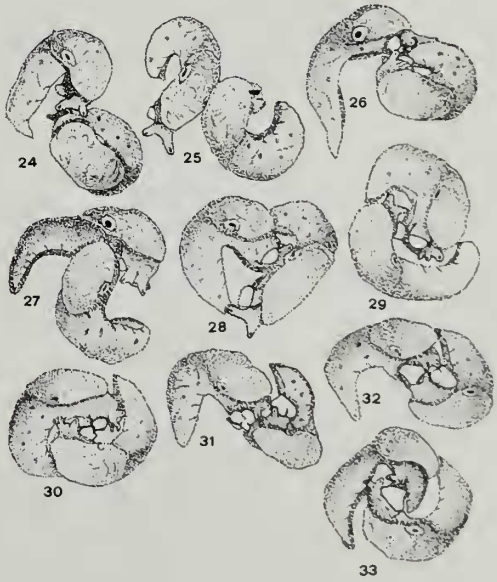
Deroceras ***geresiensis***. Copulation of two paratypes from Curral de Leonte.

Figures 13, 14. First phase.

Figures 15–18. Second phase.

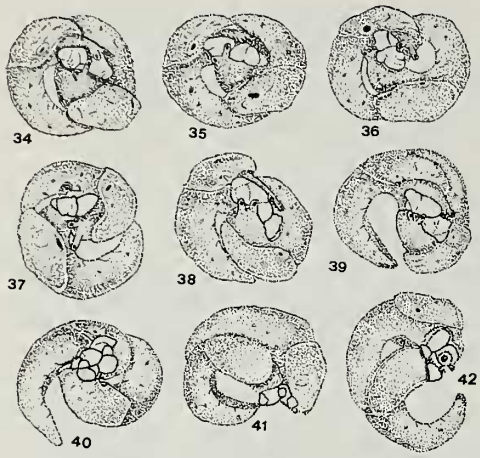
Figures 19–23. Mixed phase.

Copulation: The copulation described here was observed on 1 November 1984 in the Serra do Gerês (Portugal), in the locality named Curral de Leonte. The drawings are based on photographs taken *in situ*.



Explanation of Figures 24 to 33

Deroceras ***geresiensis***. Copulation continued from Figures 13–23, with progressive evagination of the stimulators.



Explanation of Figures 34 to 42

Deroceras ***geresiensis***. Copulation continued from Figures 24–33.

Figures 34–36. Build-up towards maximum evagination of the penis.

Figures 37–39. Initiation of sperm exchange.

Figure 40. Sperm exchange.

Figure 41. Initiation of invagination of the penis.

Figure 42. End of copulation; the stimulators are invaginated and the two animals part.

The two specimens were found head to tail forming a "C," their flanks in close proximity, under a stone near a natural meadow. The duration of the copulation is not known with accuracy, since its preliminary stages had already been completed when the pair were surprised. A few minutes after their discovery (Figures 13, 14), the two specimens parted (Figures 15–17), their genital atrium remaining evaginated. On separating, they remained side by side while each chased its own tail clockwise and licked its tip (Figure 18). After placing their flanks in contact (Figure 19), they resumed their tail-chasing, their sides touching from time to time (Figures 20–23). They then touched head to head (Figure 24) before continuing to chase their own tails side by side. This behavior was followed by contact between the partially evaginated genitalia (Figures 26, 27); after licking each other in the neighborhood of the genital orifice (Figure 28), they again placed their genital atrium in contact (Figures 29, 30); the evagination of the genitalia followed, so that two concave, linguiform structures (stimulators) appeared (Figure 31). This initiated a phase of much closer contact during which they continued to move clockwise in a circle while the distal portion of the penis was slowly evaginated (Figures 32–39). The distal penis became turgid, and two yellowish masses with the stimulators at their bases appeared on each animal (Figure 40). At this point the stimulators and yellow masses of each animal locked with those of the

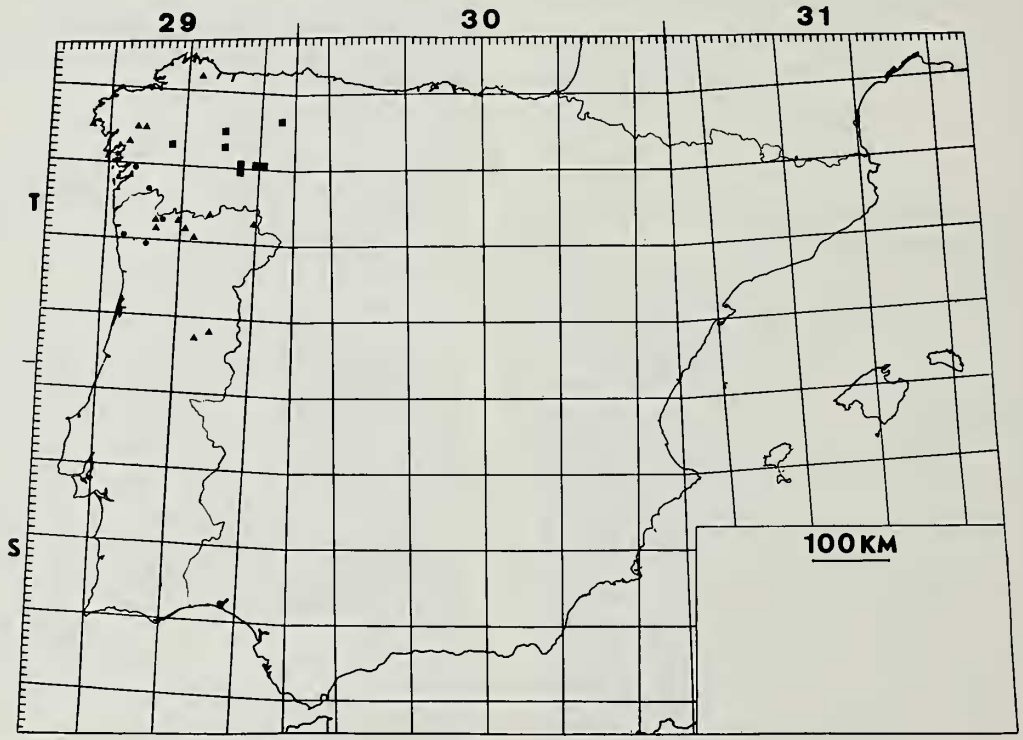


Figure 43

Map of the Iberian Peninsula, showing localities where *Deroceras* ***geresiensis*** (●), *D. lombricoides* (▲), and *Furcopenis darioi* (■) have been found.

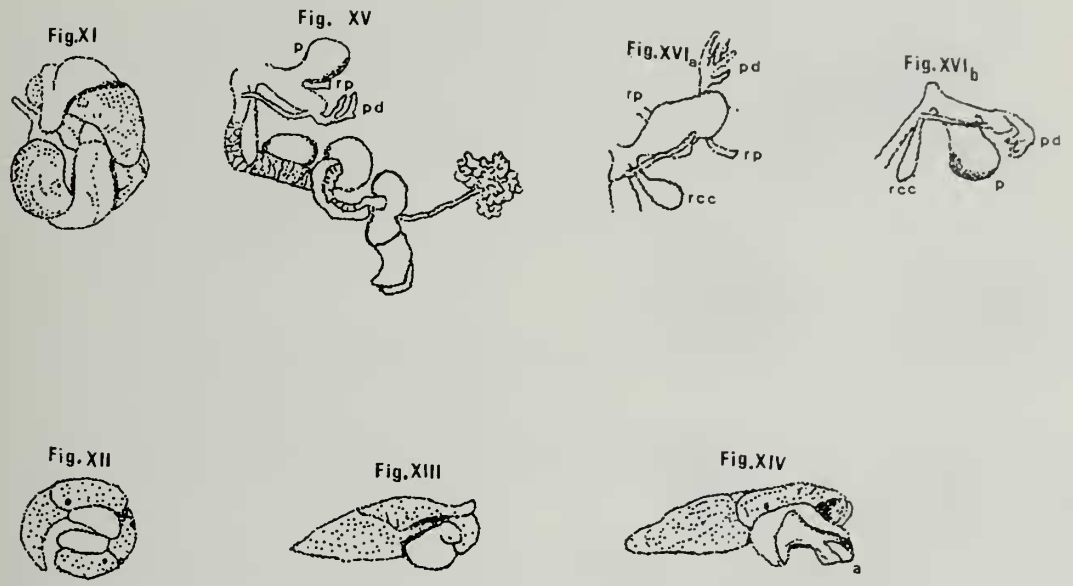


Figure 44

Part of plate 3 from SIMROTH (1891) with drawings of the genitalia and copulation of *Deroceras lombricoides* (Morelet, 1845).

other, and whitish trickles of sperm were rapidly exchanged. After this phase each specimen entirely covered itself with colorless, runny mucus. Once copulation was completed, the mucus-covered individuals gradually separated (Figures 41, 42), slowly invaginated their penes, and moved off in different directions.

In the above copulation, three phases can be distinguished. In the first, the two individuals indulge in mutual contact during which they place their genitalia, heads, or sides in contact, or lick the other's genital orifice area. In the second phase each chases and licks its own tail, though contacts with the mate also take place. During the observed copulation, these two phases were repeated in turn a total of three times. During the culminating third phase, exchange of sperm took place as described above.

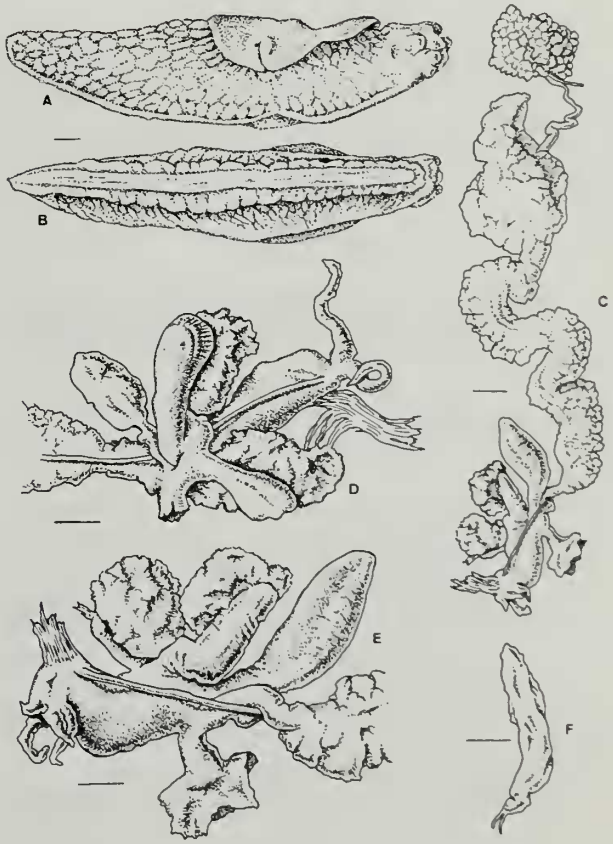


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Figure 45

Furcopenis darioi Castillejo & Wiktor, 1983. A–E. External morphology and genitalia of topotypes from Seoane, Sierra del Caurel, Spain (21 Dec. 84, *leg.* A. Outeiro). F. Spermatic mass found in the bursa copulatrix of the specimen depicted in Figure 46H. Scale, 1 mm.

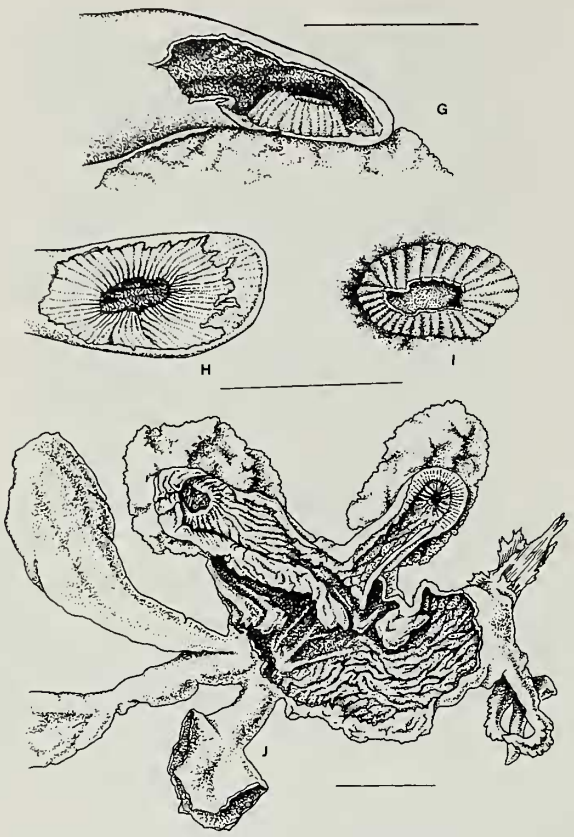

Figure 46

Furcopenis darioi Castillejo & Wiktor, 1983. Topotype from Seoane, Sierra del Caurel, Spain (21 Dec. 84, *leg.* A. Outeiro). G–I. Communication between the accessory organs and the accessory gland. J. Inside of the penis and accessory organs. Scale, 1 mm.

DISCUSSION

According to F. Giusti (personal communication, 1985), *Deroceras* ***geresiensis*** is possibly identical to *D. lombricoides* (Morelet, 1845).

Deroceras lombricoides, which has recently been re-described by CASTILLEJO *et al.* (in press), is characterized by a distal portion of the penis showing a spheroid swelling covered with a horseshoe-shaped mass of glandular tissue and housing a horseshoe-shaped stimulator corresponding to SIMROTH's (1891) description of a "pleated comb twisted upon itself many times." CASTILLEJO *et al.* (in press) also observed populations in which the free end of the stimulator was less marked, so that the stimulator became the flat fold that is characteristic of *D. immaculatum* Simroth, 1891. The difference between *D. lombricoides* and *D. geresiensis* lies in the penis: in the last species the spheroid anterior portion shows two glandular masses, each communicating with a internal tongue-like stimulator.

The pair found copulating in the Serra do Gerês (1 Nov. 84) was originally classified by CASTILLEJO & MASCATO (1987) as *Furcopenis darioi* (Figures 45, 46), a species characterized by two accessory organs on the distal portion of the penis, each tipped with an accessory gland communicating with the inside of the organ via a hollow cone with the accessory gland at its base (Figures 46g–i). *Deroceras* ***geresiensis*** has no accessory organs, and the glandular masses on its penis communicate with the inside of the penis via a lanceolate area exhibiting coarser grooving than the rest of the penis. Examination of new topotypes of *F. darioi,* and re-examination of the paratypes deposited in the Zoology Department of the University of Santiago de Compostela (Spain), have confirmed that the accessory bodies are a constant feature even among juveniles, so that it hardly seems possible that their absence from the specimens described here as *D.* ***geresiensis*** can be due to intraspecific variation. The geographical distribution of the two species is likewise different: *F. darioi* has so far been collected only in soils developed from schists in El Bierzo (León, Spain) and neighboring areas, whereas *D.* ***geresiensis*** is a more coastal species found only in granitic soils of the Portuguese Costa Verde and the south of the Spanish province of Pontevedra. No specimens of either species have been found at sampled sites between these two territories.

Finally, *Deroceras* ***geresiensis*** is differentiated from *D. dalmatinum* Grossu, 1972, by having its two stimulators located symmetrically on the proximal penis, whereas *D. dalmatinum* has a papillose stimulator on the proximal penis and a curved stimulator on the distal penis.

ACKNOWLEDGMENT

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